

Physiological and Environmental Sensor Skin Stamp

Completed Technology Project (2016 - 2016)



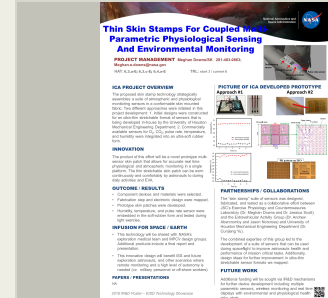
Project Introduction

Future exploration missions will require astronauts to autonomously monitor physiological and atmospheric conditions. Recent technological advances in the developing field of wearable technologies has led to designs capable of measuring atmospheric conditions in addition to the more common physiological monitoring uses; however, these separate capabilities have not been packaged into a single monitoring system with real-time feedback. A conformable and flexible "skin stamp" instrumented with electronics and sensors to measure atmospheric conditions and physiological health during daily exercise, EVA, and exploration tasks would provide an easy to implement method to protect astronauts' health and save cost and space during all phases of the Journey to Mars. Additionally, advancement of this technology could be used to immediately enhance ISS medical monitoring capabilities and in other isolated environments such as military training and off shore rigging.

Advancing human exploration beyond low earth orbit and ISS will require improved and more autonomous health monitoring systems, highlighting the importance of integrating multiple medical devices in one platform with focus on early detection of remediable conditions. Skin-mounted biosensors provide the capability to monitor indicators of physical performance and fatigue (i.e. heart rate, hydration, temperature, oxygen saturation). NASA exploration needs requirements document specifically calls out capabilities for environmental monitoring to quickly detect changes that could result in an unfavorable habitation. As an example, daily exercise sessions may stress the Environmental Control and Life Support (ECLS) Systems on exploration vehicles due to heat generation, sweat production, and carbon dioxide accumulation. Accordingly, there is a need to develop sensors that can simultaneously monitor physiological health and atmospheric conditions (i.e. temperature, humidity, gas concentrations) during Mars proving-ground and Earth-Independent missions. The proposed wearable "skin stamp" multi-parametric sensor will be a novel design with dual-use technology in mind to monitor both biomedical and atmospheric conditions in a single platform

The proposed "skin stamp" sensor will be designed, fabricated, and tested as a collaborative effort between SK and University of Houston Engineering Department. The teams expertise in sensor and materials design, physiological monitoring and testing, and exploration are necessary to successfully develop a suite of sensors in a single platform that is optimized for exploration within the budget and time constraints of this ICA. We propose to strategically assemble a suite of atmospheric and physiological monitoring sensors in a conformable skin mounted fabric and integrate key design features including ease of use, single platform, high data quality, durability, and real-time monitoring. We will leverage previous high-performance flexible electronic material assemblies developed by UH. The hardware will undergo rigorous evaluations at different environmental temperatures.

The product of this effort will be a novel prototype multi-sensor skin patch that



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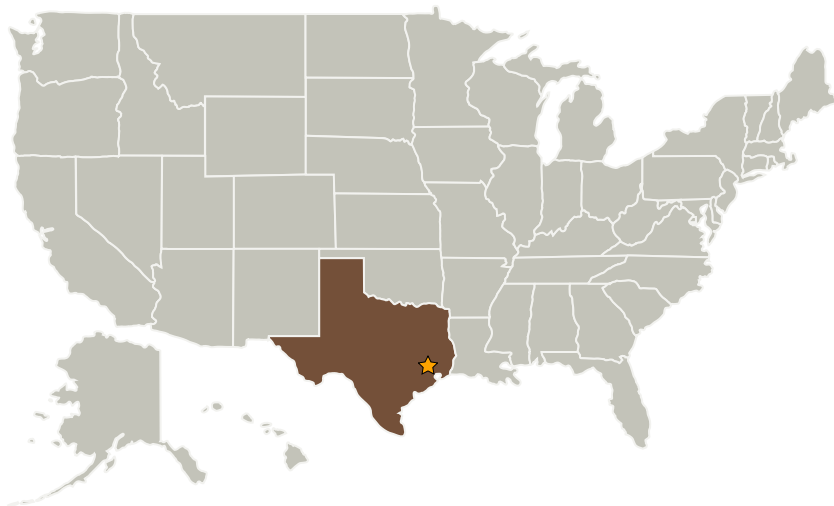
allows for accurate, real-time physiological and atmospheric monitoring in a single platform design. The first 8 weeks will focus on sensor development, followed by 4 weeks of engineering evaluations, and 4 weeks of human testing. Additional products will include a final report, poster presentation, and JTWG out-briefing that detail the innovative design and potential physiological benefits to astronauts as well as other scenarios requiring remote medical care such as military personnel or off-shore workers.

Following successful design, fabrication, and testing, this novel skin patch sensor will be shared with NASA's exploration medical team and MPCV design group. Additional funding will be sought via IR&D mechanisms for further device development to allow for wireless monitoring and real-time displays with environment and physiological health risk alerts.

Anticipated Benefits

The proposed wearable "skin stamp" multi-parametric sensor will be a novel design with dual-use technology in mind to monitor both biomedical and atmospheric conditions in a single platform

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Independent Research & Development: JSC IRAD

Project Management

Program Manager:

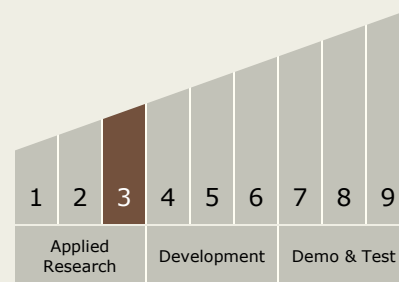
Carlos H Westhelle

Principal Investigator:

Meghan E Downs

Technology Maturity (TRL)

Start: 3

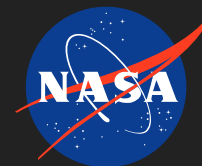


Technology Areas

Primary:

Continued on following page.

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Completed Technology Project (2016 - 2016)

Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
University of Houston	Supporting Organization	Academia	Houston, Texas

Co-Funding Partners	Type	Location
University of Houston	Academia	Houston, Texas

Primary U.S. Work Locations

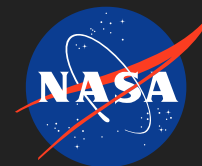
Texas

Technology Areas
(cont.)

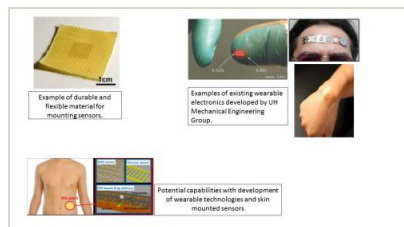
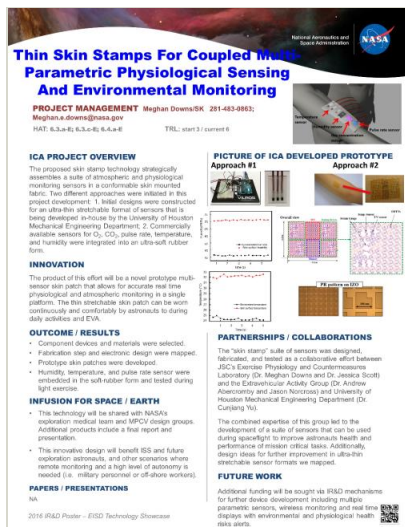
- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.3 Human Health and Performance
 - └ TX06.3.4 Contact-less / Wearable Human Health and Performance Monitoring

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Images



Skin Mounted Sensor Technology

Developments in skin mounted sensor technologies
(<https://techport.nasa.gov/image/20896>)

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(<https://techport.nasa.gov/image/26143>)